Asia. Some health experts attribute this to the fact that many poor people in the United States, especially minorities, cannot afford good health care for their infants.

Life expectancy at birth measures the average number of years a newborn infant can expect to live at current mortality levels. Like every other mortality and fertility rate discussed thus far, life expectancy is most favorable in the wealthy countries of Western Europe and least favorable in the poor countries of sub-Saharan Africa. Babies born today can expect to live into their late seventies in Western Europe but only into their forties in most sub-Saharan African countries (Figure 2–11).

Natural increase, crude birth, total fertility, infant mortality, life expectancy—the descriptions have become repetitious because their distributions follow similar patterns. More developed regions of the world have lower rates of natural increase, crude birth, total fertility, and infant mortality, and higher average life expectancy. Higher natural increase, crude birth, total fertility, and IMRs, and lower average life expectancy are found in LDCs.

The final world map of demographic variables—CDR—does not follow the familiar pattern (Figure 2–12). The combined CDR for all LDCs is actually lower than the combined rate for all MDCs. Furthermore, the variation between the world's highest and lowest CDRs is much less extreme than the variation in CBRs. The highest CDR in the world is 19 per 1,000, and the lowest is 1—a difference of 18—whereas CBRs for individual countries range from 8 per 1,000 to 55, a spread of 47.

Why does Denmark, one of the world's wealthiest countries, have a higher CDR than Mongolia, one of the poorest? Why does the United States, with its extensive system of hospita and physicians, have a higher CDR than Mexico and eve country in Central America? The answer is that the populatio of different countries are at various stages in an importa process known as the demographic transition, upon which v focus in the third key issue of this chapter.

KEY ISSUE 3

Why Is Population Increasing at Different Rates in Different Countries?

- The demographic transition
- Population pyramids
- Countries in different stages of demographic transition
- Demographic transition and world population growth

All countries have experienced some changes in natural increase, fer and mortality rates, but at different times and at different rates. Alth rates vary among countries, a similar process of change in a society's ulation, known as the **demographic transition**, is operating. Becau diverse local cultural and economic conditions, the demographic tran diffuses to individual countries at different rates and produces local v tions in natural increase, fertility, and mortality.

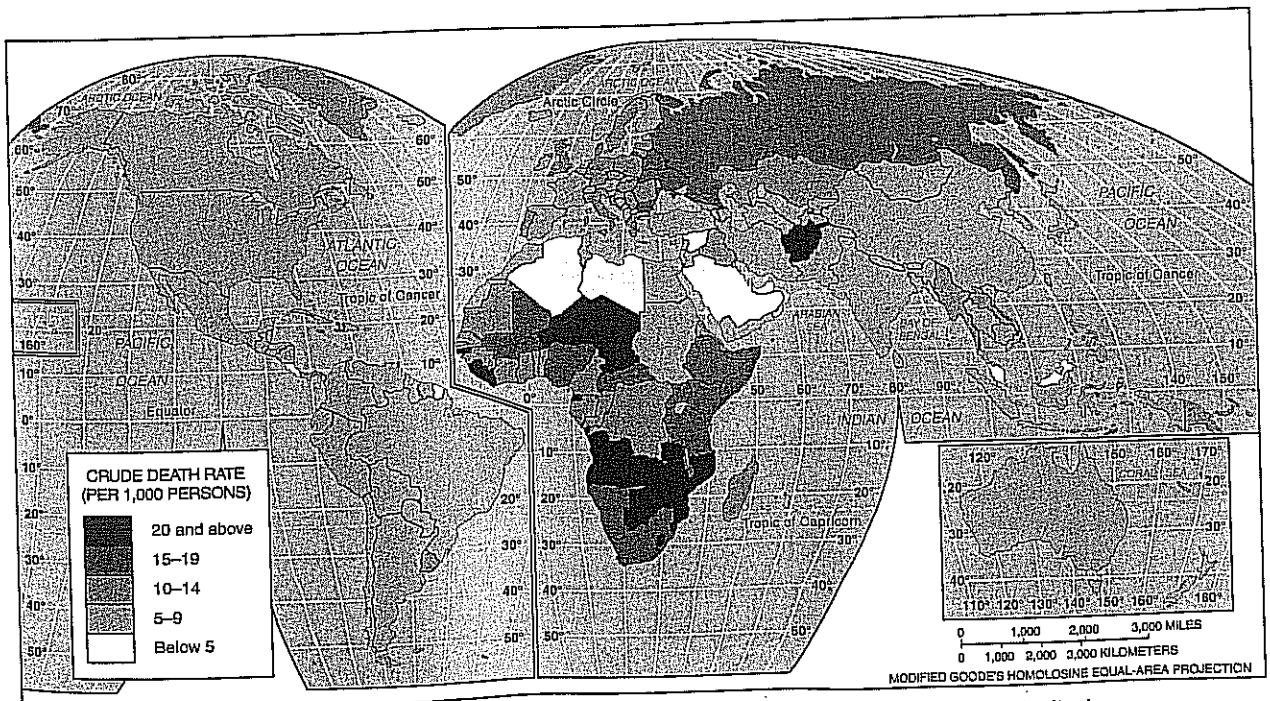

FIGURE 2–12 Crude death rate (CDR). Crude death rate is the total number of deaths in a year for every 1,000 people alive in the society. The global pattern of crude death rates varies from those for the other demographic variables already mapped in this chapter. First, although Europe has the lowest natural increase, crude birth, and infant mortality rates, it has relatively high crude death rates. Second, the variance between the highest and lowest crude death rates is much lower than was the case for the crude birth rates. The concept of the demographic transition helps to explain the distinctive distribution of crude death rates.

The Demographic Transition

The demographic transition is a process with several stages, and every country is in one of them. The process has a beginning, middle, and end, and—barring a catastrophe such as a nuclear war—it is irreversible. Once a country moves from one stage of the process to the next, it does not revert to an earlier stage. The four stages are shown in Figure 2–13.

Stage 1: Low Growth

Most of humanity's several-hundred-thousand-year occupancy of Earth was characterized by stage 1 of the demographic transition. Crude birth and death rates varied considerably from one year to the next and from one region to another, but over the long term they were roughly comparable, at very high levels. As a result, the NIR was essentially zero, and Earth's population was unchanged, at perhaps a half million.

During most of this period, people depended on hunting and gathering for food (see Chapter 10). When food was easily obtained, a region's population increased, but it declined when people were unable to locate enough animals or vegetation nearby.

About the year 8000 B.C., the world's population began to grow by several thousand per year. Between 8000 B.C. and A.D. 1750, Earth's human population increased from approximately 5 million to 800 million (Table 2–2). The burst of population growth around 8000 B.C. was caused by the **agricultural revolution,** which was the time when human beings first domesticated plants and animals and no longer relied entirely on hunting and gathering. By growing plants and raising animals, human beings created larger and more stable sources of food, so more people could survive.

Despite the agricultural revolution, the human population remained in stage 1 of the demographic transition because food supplies were still unpredictable. Farmers prospered in regions with abundant harvests, and the population expanded, but when unfavorable climatic conditions resulted in low food production, the CDR would soar. War and disease also took their toll in stage 1 societies.

Most of human history was spent in stage 1 of the demographic transition, but today no such country remains there. Every nation has moved on to at least stage 2 of the demographic transition, and, with that, transition has experienced profound changes in population.

Stage 2: High Growth

For nearly 10,000 years after the agricultural revolution, world population grew at a modest pace. After around A.D. 1750, the world's population suddenly began to grow ten times faster than in the past. The average annual increase jumped from about 0.05 percent (one-twentieth of 1 percent) to 0.5 percent (one-half of 1 percent). World population grew by about 5 million in 1800, compared to only about one-half million in 1750.

The sudden burst of population growth occurred in the late eighteenth and early nineteenth centuries because several countries moved on to stage 2 of the demographic transition. In stage 2 of the demographic transition, the CDR suddenly plummets, while the CBR remains roughly the same as in stage 1. Because the difference between the CBR and CDR is suddenly very high, the NIR is also very high, and population grows rapidly.

Some demographers divide stage 2 of the demographic transition into two parts. The first part is the period of accelerating population growth. During the second part, the growth rate begins to slow, although the gap between births and deaths remains high.

Countries entered stage 2 of the demographic transition after 1750 as a result of the **Industrial Revolution,** which began in England in the late eighteenth century and spread to the European continent and North America during the nineteenth century. The Industrial Revolution was a conjunction of major improvements in industrial technology (invention of the steam engine, mass production, powered transportation) that transformed the process of manufacturing goods and delivering them to market (see Chapter 11). The result of this transformation was an unprecedented level of wealth, some of which was used to make communities healthier places to live.

New machines helped farmers increase agricultural production and feed the rapidly growing population. More efficient agriculture freed people to work in factories, producing other goods and generating enough food for the industrial workers.

The wealth produced by the Industrial Revolution was also used to improve sanitation and personal hygiene. Sewer systems were installed in cities, and food and water supplies were

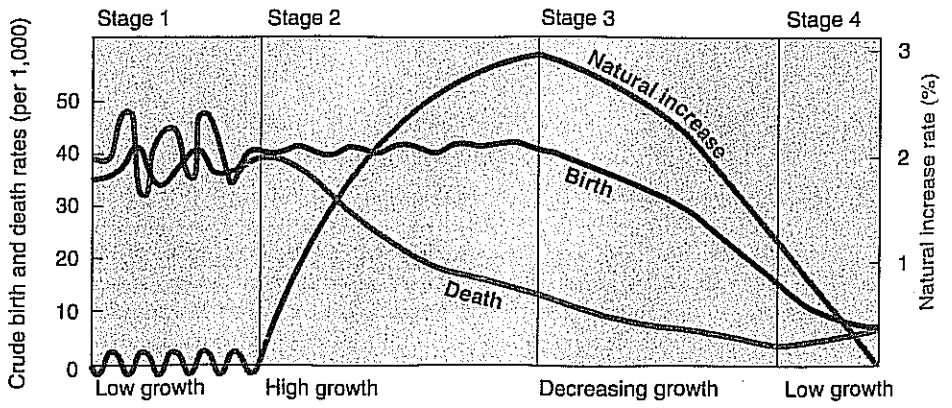

FIGURE 2–13 Demographic transition. The demographic transition consists of four stages: stage 1—very high birth and death rates produce virtually no long-term natural increase; stage 2—rapidly declining death rates combined with very high birth rates produce a very high natural increase; stage 3—birth rates rapidly decline, death rates continue to decline, and natural increase rates begin to moderate; and stage 4—very low birth and death rates produce virtually no long-term natural increase, and possibly a decrease.

TABLE 2–2 | World Population and Growth Rates

DATE	ESTIMATED POPULATION	PERCENT AVERAGE YEARLY GROWTH IN PRIOR PERIOD	NUMBER OF YEARS IN WHICH POPULATION DOUBLES AT CURRENT GROWTH RATE
400,000 B.C.	500,000	—	
8000 B.C.	5,000,000	0.001	59,007
A.D. 1	300,000,000	0.05	1,354
1750	795,000,000	0.06	1,250
1800	985,000,000	0.43	163
1850	1,266,000,000	0.51	136
1900	1,656,000,000	0.54	129
1950	2,516,000,000	0.81	85
2000	6,080,000,000	1.75	40

protected against contamination. As a result of these public improvements, people were healthier and therefore lived longer.

Countries in Europe and North America entered stage 2 of the demographic transition about 1800, but stage 2 did not diffuse to most countries in Africa, Asia, and Latin America until around 1950. With the diffusion of stage 2 of the demographic transition, world population grew by 1.7 percent per year during the second half of the twentieth century, compared to 0.5 percent per year during the nineteenth century. The world added about 80 million people in 2000, compared to 8 million in 1900.

Countries in Africa, Asia, and Latin America moved on to stage 2 of the demographic transition during the second half of the twentieth century for a different reason than was the case for Europe and North America 200 years earlier. The late twentieth-century push of countries into stage 2 was caused by the **medical revolution.** Medical technology invented in Europe and North America diffused to less developed countries in Africa, Asia, and Latin America.

Improved medical practices suddenly eliminated many of the traditional causes of death in LDCs and enabled more people to experience longer and healthier lives. English physician Edward Jenner discovered in 1796 that a person exposed to cowpox could develop an immunity to smallpox. He inoculated an 8-year-old boy first with the cowpox virus then with the deadly smallpox virus, but the boy did not develop the disease. Immunization against other diseases followed. Penicillin, vaccines, and insecticides effectively and inexpensively controlled other infectious diseases, such as malaria and tuberculosis.

Stage 3: Moderate Growth

A country moves from stage 2 to stage 3 of the demographic transition when the CBR begins to drop sharply. The CDR continues to fall in stage 3 but at a much slower rate than in stage 2. The population continues to grow because the CBR is still greater than the CDR. But the rate of natural increase is more modest in countries in stage 3 than in those in stage 2 because the gap between the CBR and the CDR narrows.

European and North American countries generally moved from stage 2 to stage 3 of the demographic transition during the first half of the twentieth century. Most countries in Asia and Latin America have moved to stage 3 in recent years, while most African countries remain in stage 2.

The sudden drop in the CBR during stage 3 occurs for different reasons than the rapid decline of the CDR during stage 2. The CDR declined in stage 2 following the introduction of new technology into the society, but the CBR declines in stage 3 because of changes in social customs.

A society enters stage 3 of the demographic transition when people choose to have fewer children. The decision is partly a delayed reaction to a decline in mortality, especially the IMR. In stage 1 societies, the survival of any one infant could not be confidently predicted, and families typically had a large number of babies so as to improve the chances of some surviving to adulthood. Medical practices introduced in stage 2 societies greatly improved the probability of infant survival, but many years elapsed before families reacted by conceiving fewer babies.

Economic changes in stage 3 societies also induce people to have fewer offspring. People in stage 3 societies are more likely to live in cities rather than in the countryside, and to work in offices, shops, or factories rather than on farms. Farmers often consider a large family to be an asset because children can do some of the chores. In contrast, children living in cities are generally not economic assets to their parents, because they are prohibited from working in most types of urban jobs. In addition, urban homes are relatively small and may not have space to accommodate large families.

Stage 4: Low Growth

A country reaches stage 4 of the demographic transition when the CBR declines to the point where it equals the CDR, and the NIR approaches zero. This condition is called **zero population growth (ZPG),** a term often applied to stage 4 countries.

ZPG may occur when the CBR is still slightly higher than the CDR, because some females die before reaching childbearing years, and the number of females in their childbearing years can vary. To account for these discrepancies, demographers more precisely define ZPG as the TFR that results in a lack of change in the total population over a long term. A TFR of approximately 2.1 produces ZPG, although a country that receives many immigrants may need a lower TFR to achieve ZPG.